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Enhancement of soybean (*Glycine Max (L)* Merrill) production and productivity, in Ethiopia

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Abstract
Background: Soybean (Glycine max (L.) Merrill) is the highest protein content among other leguminous crops in the world and it can be used as a source food for human being and animals. Weak soil fertility management and poor cropping, system limited yield of the crop.
Methods: Management of agronomic practices in soybean includes, soil fertility, weeding, plant popuation, crop protection speciaaly disease and pests, harvesting and post harvest management practices are highly important for the improvement of production and productivity of soybean.
Conclusion: Certainely, to bring high production and productivity of soybean requires great, attention from responsible bodies on the expansion of awareness creation for farmers through training on production and productivity activities, intervention on the expansion of irrigable land and motivating the agricultural experts have been suggested.

Keywords: soybean, plant nutrients, plant population

Introduction
Soybean (*Glycine max (L.)* Merrill*)* is a significant leguminous crop, which grow in the tropical, subtropical and temperate climates. According to Rajcan *et al*., 2005 [52] and Hartman *et al*., 2011[29] soybean is the largest oil and protein content of leguminuous crops in the world, which used as a source food for human being and animals. Global soybean production has been on the rised from time to time and it is estimated demand of about 300 million tons exceeds the current supply by over 40 million tons (FAOSTAT, 2010). As stated by Hartman *et al*., 2011 the soybean yields was less than 30% of actual potential land only about 7% of favorable land allocated to soybeans, SSA presents a great opportunity for closing this global demand-supply gap. According to the study of Ali, 2010[6] soybean protein provides all eight amino acids and best source of protein and oil. Soil acidity can limit the survival and growth of Rhizobia in soil and can also affect the process of nodulation and N_2 fixation (Habtamu *et al*., 2018) [25]. As indicated by Havlin *et al*., 2005 at the soil pH, values less than 5.5 to 6.0, can drastically affect rhizobial infection, root growth, and legume productivity. Increased seed rate will influence yield to a point, however, yield will eventually reach a maximum at which addition of more seed will do nothing to increase. As explained by Zafar *et al*., 2013 & Jones *et al*., 1977 [37] the low availability of phosphorus nutrition in soils has become the limiting factor for plant and root growth. According to the study of Tahir *et al*., 2009[60] & Israel, 1987 [35] legume plants that depend on biological N_2 fixation for their N supply require more P and other macro and micro nutrients than plants receiving fertilizer N since the reduction of atmospheric N_2 by the nitrogenous system is a very energy-consuming process and more P and other nutrients are needed for symbiotic N fixation than for general plant metabolism Nitrogen is the most important nutrient for crop production and its deficiency occurs in most countries of the world.

According to the studies of Gan *et al*., 2003, Galarao, 1992, Patel *et al*., 1992 [50] & Wantanabe *et al*., 1983 reported that Nitrogen and phosphorus are considered necessary for grain yield of soybean.
As explained by the study of Habtamu *et al*., 2018 [25] lack of the right type and amount of fertilizers; poor soil fertility management practices and poor agronomic management practices, such as improper weed management, inappropriate plant population and planting time. In addition, the lack of improved varieties having desirable traits such as nutrient use efficiency, disease resistance, and high yielding ability also magnified the problem.
Therefore, this paper was initiated to review on the enhancement of soybean (*Glycine Max (L)* Merrill) Production and Productivity, South Western Ethiopia

Soybean production constraints in Ethiopia
Despite the early introduction it was not easy to achieve wider dissemination and production of soybean; especially among the small scale farmers. The main limitations for this were: lack of awareness by the local farmers on how to grow the crop, unavailability of an good market for the produce, and lack of a systematic approach for popularizing the crop through training farmers on how to prepare different meals from soybean (Habtamu *et al*., 2018) [25].

Response to N and P fertilizers
According to the studies of Schulze *et al*., 2006 [54], O' Hara *et al*., 2002, Drevon and Hartwig, 1997 and Israel, (1987 [35] reported that phosphorus (P) and nitrogen (N) have play specific role in symbiotic N_2-fixation through their effects on nodulation and N_2-fixation process.
According to the study of Habtamu *et al*., 2018 [25] and Gan *et al*., 2003 nitrogen requirement for soybean are typically met by a combination of soil-derived and provided through the process of symbiotic fixation from Rhizobia bacteria in root nodules.

Effects of planting density

Management of agronomic practices are a major factor that manipulates micro environment of the crop field which affects growth, development and yield formation of crops. According to the studies by Habtamu *et al*., 2018 [25] Caliskan *et al*., 2007 [19] reported that among the m ajor agronomic practices plant population desity is the one which is limits, the growth and yield per plant but the reverse occurs for yield per unit area.

Number of branch per plant

According to studies of Habtamu *et al*., 2018 [25], Ball *et al*., 2000 [9] and Boquet, 1990 [16] which found that increasing plant population density can decrease both branch and main stem yields per plant. It resulted in a decrease in total branch yield but an increase in total stem yield because the increase in plant population offsets the stem yield loss but not the branch yield loss.

Leaf area

Leaf area compensation for defoliation may be expressed through changes in new leaf area expansion or in normal plant senescence. Experimental data measuring leaf area recovery were reported by Habtamu *et al*. 2018 [25] who found a general trend of high recovery when treatments were applied on vegetative stages, with recovery indexes being more intense at high defoliation levels.

Number of nodules

According to study of Nyoki and Ndakidemi, 2014 which reported as an inoculation is not usually favoured below pH 5.5. As the study of the Bekere and Hailemariam, 2012[11] reported that no differences in nodule number were produced when different phosphorus levels were used in Ethiopia.

Table 1: main effect of population and NP fertilizer on Plant height leaf area, number of leaves, fresh weight of soybean at kersa Woreda of jimma zone, south western Ethiopia

Plant population	PH	NL	LA	FW	DW
Pop1	48.23[a]	75.39[a]	174.04[a]	41.84[a]	9.10[a]
Pop2	46.24[a]	73.67[ab]	168.55[a]	39.86[a]	8.625[a]
Pop3	44.39[a]	69.20[b]	163.22[a]	28.53[b]	6.44[b]
Pop4	44.39[a]	70.35[b]	149.27[b]	27.88[b]	6.85[b]
LSD(0.05)	ns	4.48	11.48	6.30	1.41
NP fertilizer					
N1P1	38.82[b]	61.92[d]	150.47[c]	35.09[a]	7.87[a]
N2P2	46.41[ab]	68.20[c]	160.44[bc]	33.69[a]	7.66[a]
N3P3	45.62[ab]	75.42[b]	163.71[b]	36.11[a]	7.75[a]
N4P4	52.55[a]	83.07[a]	180.47[a]	33.21[a]	7.73[a]
LSD(0.05)	8.19	4.48	11.48	6.31	ns
CV (%)	21.44	7.46	8.42	21.90	24.23

Means followed by the same letter(s) are not significantly different at 5% p level

Number of Pod per plant

As explained by Epler and Staggenborg, 2008 Robinson & Wilcox, 1998 plant density affected soybean yield and yield components in narrow rows. Board and Harville, 1992 [13] and Oplinger and Philbrook, 1992[48] reported that usually soybean seed yield increases with decreasing row width up to a certain point, after that a further decrease in row width may negatively affect seed yields. According to the studies of Agha *et al*., 2004 [4], Akbari, 2001, Tola, 1995 and Xuewen, 1990 increasing levels of nitrogen fertilization increased the number of pods per plant. As the studies of Maneechote, (1991) [41] and Hantolo, (1995) [28] observed that increasing the levels of nitrogen fertilization had no effect on mean number of pods per plant.

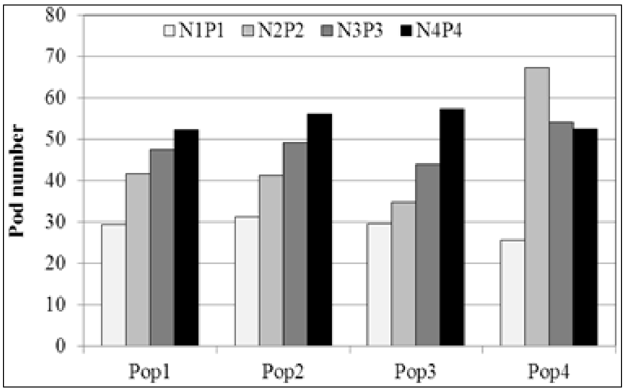

Fig 1

Number of seed per pod

As reported by Habtamu *et al.*, 2018 [25], Agha *et al*., 2004 [50] & Akbari *et al*., 2001 the number of seeds per pod for any given cultivar of leguminous plant is a relatively stable character wchich means that number of seeds per pod was slightly affected by the levels of nitrogen fertilization as noticed by others. Also as stated by Hassan, (1987) soybean rhizobium inoculation had no effect on number of seeds.

Grain yield

As studied by Habtamu *et al*., 2018 [25] and Starling *et al.* 2000[59] plant growth and grain yield of soybean were higher when fertilizer nitrogen was applied as starter and the response of crop to the nitrogen application is because nitrogen plays an important role in the synthesis of chlorophyll and amino-acids which are the indispensable ingredients of the process of autotrophization. Nitrogen influenced grain yield through source–sink relationships resulting in higher production of photosynthesis and their increased translocation to reproductive parts Tripathi *et al.* (1992) [66].

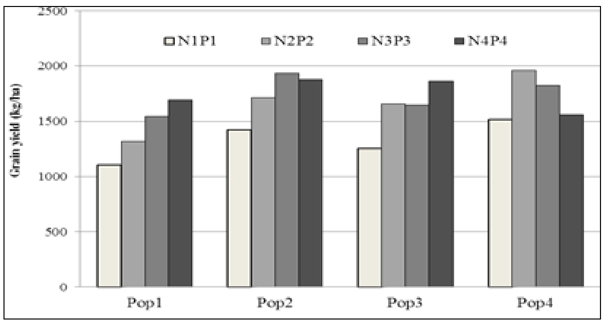

Fig 2

Conclusion

Soybean (*Glycine max*) is one of the world's most important legumes in terms of production and trade and has been a dominant oilseed. It grows in the tropical, subtropical and temperate climates. Like peas, beans, lentils and peanuts, it belongs to the large botanical family, Leguminosae, in the subfamily Papilionideae. Overall it can be concluded that soybean can be successfully grown in recycling of organic fertilizer and chemical fertilizers. The diversification measure in agriculture used for improving productivity, energy use efficiency, profitability. Growing soybean by good management practices with best cropping system can make an important contribution to increase production and productivity. Among the good management agronomic practices management is crucial for the best yield and productivity of the crop. Hence, as a future line of work further works that consider crop growing season, ecology, soil types and different fertilizers application, crop protection and management of agronomic practices are needed for increased production and productivity of soybean.

References

1. Abate T, Alene A, Bergvinson D, Silim S, Asfaw S,. Tropical Legumes in Africa and South Asia: Knowledge and opportunities. TL II Research Report No. 1, ICRISAT Nairobi vi, 2012, 104
2. Abendroth L, Elmore R, Ferguson R. Soybean inoculation University of Nebraska-Lincoln Extension pub G1621. University of Nebraska-Lincoln, 2006.
3. Acikgoz E, Sincik A, Karasu O, Tongel G, Wietgrefe U, Bilgili M *et al*. Forage soybean production for seed in Mediterranean environments Field Crops Res,2009:110:213-218.
4. Agha S, Oad F, Buriro U. Yield and yield components of inoculated and un inoculated soybean under varying Nitrogen levels Asian J. of plant Sci,2004:3(3):370-371
5. Akbari G, Scarisbrick D, Peat W 2001. Soybean (*Glycine max L. Merrill*) yield and yield components response to nitrogen supply and wither changes in south-east of England. Agron. Tehran, Iran J. Agric,2004:3:(1):15-32.
6. Ali N. Soybean processing and utilization In G. Singh (Ed.), the soybean. CABI, 2010, 345-374.
7. Asfaw A, Tesfaye A, Alamrie S, Atnaf M. Soybean genetic improvement in Ethiopia, 2006, 22-26
8. Asrat F. Progress Report on Cereals, Pulses and Oilseeds Research, Branch Experiment Station Debre Zeit Ethiopia, 1965.
9. Ball R, Purcell L, Vories E. Optimizing soybean plant population for a short-season production system in the Southern USA Crop Sci,2000:40:757-764
10. Bekere W, Kebede T, Dawud J. Growth and Nodulation Response of Soybean (*Glycin max L.)* to Lime, Bradyrhizobium japonicum and Nitrogen Fertilizer in Acid Soil at Melko, South Western Ethiopia. Int. J. Soil sci,2013:8(1):25-31.
11. Bekere W, Hailemariam A. Influence of inoculation methods and phosphorus rates on nitrogen fixation attributes and yield of soybean (*Glycine max L.)* at Haru, Western Ethiopia,2012:7(30):4266-4270.
12. Bertram M, Pedersen P. Adjusting management practices using glyphosate-resistant soybean cultivars Agron J,2004:96:462-468.
13. Board J, Harville B. Explanations for greater light interception in narrow-vs wide-row soybean Crop Sci,1992:32:198-202.
14. Board J, Harville B, Saxton M. Narrow-row seed-yield enhancement in determinate soybean Agron J,1990:82:64-68.
15. Bojović B, Marković A. Correlation between nitrogen and chlorophyll content in wheat (*Triticum aestivum L.).*Kragujevac Journal of Science,2009:31:69-74.
16. Boquet D. Plant population density and row spacing effects on soybean at post-optimal planting dates Agron J,1990:82:59-64
17. Brady N, Weil R. The Nature and Properties of Soils 14thed., Prentice Hall, Upper Saddle River, N J, USA, 2008
18. CACC. Report on the preliminary results of area, production and yield of temporary crops (Meher season, private peasant holdings) part I. Central Agricultural Census Commission, Addis Ababa, Ethiopia, 2002, 200.
19. Caliskan S Aslan M, Uremis I and Caliskan E. The effect of row spacing on yield and yield components of full season and double cropped soybean Turk J. Agric,2007:31:147-154.
20. Collombet RN. "Investigating soybean market situation in Western Kenya: constraints and opportunities for smallholder producers", Wageningen University, 2013, 1-43
21. CSA (Central Statistical Authority). Report on the preliminary results of area, production and yield of temporary crops. Central Statistical Authority, Ethiopia.
22. FAO (Food and Agriculture Organization), 20011. Plant nutrition for food security: A guide for integrated nutrient management. FAO, Fertilizer and Plant Nutrition Bulletin 16, Rome, 2013.
23. FASOSTAT (Food and Agricultural Organization of the United Nations), 2011. ://faostat3.org/home/ index/html.
24. Gurmu F. Overview of Soybean Research in Ethiopia Hawassa: SARI. Gyaneshwar, P., Kumar, G.N., Parekh, L.J. and Poole, P.S, Role of soil microorganisms in improving P nutrition of plants. Plant Soil,2010:245:83-93.
25. Habtamu D, Taye K, Amsalu N. Response of Soybean (Glycine max (L) Merrill) to Plant Population and NP Fertilizer in Kersa Woreda of Jimma Zone, South Western Ethiopia. Int. J. Curr. Res. Aca. Rev,2018:6(9), 50-71.
26. Hailegiorgis B. Export performance of oilseeds and its determinants in Ethiopia Haramaya University, College of Agriculture and Environmental Science, Department of Agricultural Economics, 2010.
27. Hailu M, Kelemu K. Trends in Soy Bean Trade in Ethiopia. Research Journal of Agriculture and Environmental Management,2014:3(9):477-484.
28. Hantolo C. Nitrogen fertilizer effect on yield component of vegetable soybean AVRDC-TOP 9th Training Report 1995.Kasetsart University, Bangkok, and Zambia, 1995, 1-4
29. Hartman G, West E, Herman T. Crops that feed the World 2 Soybean-worldwide production, use, and constraints caused by pathogens and pests Food Sec,2011:3:5-17
30. Haru A, Ethiopia W. Influences of Inoculation Methods and Phosphorus Levels on Nitrogen Fixation Attributes and Yield of Soybean (*Glycine max L.)* American Journal of Plant Nutrition and Fertilization Technology,2012:2(2):45-55
31. Hymowitz T, Shurtleff W. Debunking soybean myths and legends in the historical and popular literature Crop Sci,2005:45:473-476

32. IITA. Thirty years R4D in soybean: what's next, 2008. r4dreview.org/tag/soybean/ (accessed14/07/2010) accessed date 15/09/2015
33. Imsande J. Rapid dinitrogen fixation during soybean pod fill enhances net photosynthetic output and seed yield: A new perspective. Agronomy Journal,1989:81:549-556.
34. Isherword K. Fertilizer use and environment *In*: N. Ahmed and A. Hamid (eds.), Proc. Symp. Plant Nutrition Management for Sustainable Agricultural Growth NFDC, Islamabad, 1998, 57-76
35. Israel D. Investigations of the role of phosphorus in symbiotic di nitrogen fixation Plant Physiol,1987:84:835-840.
36. Jagwe J, Owuor G. Evaluating the marketing opportunities for soybean and its products in the East African countries of asareca: Kenya Report International institute of Tropical Agriculture-FOODNET, 2004.
37. Jones G, Lutz A, Smith T. Effects of phosphorus and potassium on soybean nodules and seed yield. Agron. J,1977:69:1003-1006
38. Kamara A, Abaidoo R, Kwari J, Omoigui L. Influence of phosphorus application on growth and yield of soybean genotypes in the tropical savannas of northeast Nigeria. Arch. Agron. Soil Sci,2007:53:539-552
39. Kasturikrishna S, Ahlawat P. Growth and yield response of pea (*Pisum sativum*) to moisture stress, phosphorus, sulphur and zinc fertilizers. Ind J Agron,1999:44:588-596
40. Liu X, Jin J, Wang G, Herbert S. Soybean yield physiology and development of high-yielding practices in Northeast China. Field Crops Research,2008:105:157-171.
41. Maneechote P. Fertilizer effect on vegetable soybean yield AVRDC-TOP 9th Training Report 1991. Kasetsart University, Bangkok, Thailand, 1991, 52-57
42. MARD. Crop variety register. Ministry of Agriculture and Rural Development, Crop Development Department, Addis Ababa Ethiopia, 2012, 15.
43. Mesfin A. State of soil science development for agriculture in Ethiopia Ethiopian Journal of Agricultural Sciences,1980:2:139-157.
44. Newman JL, Mehretu A, Shillington K, Stock R. ``Africa''Microsoft Student 2008. [DVD] Microsoft Corporation. Redmond, WA, 2007.
45. Nyoki D, Ndakidemi P. Effects of Bradyrhizobium japonicum inoculation and supplementation phosphorus onmacronutrients uptake in cowpea, 2014.
46. Ogema M. "Oil crop Production in Kenya: Vegetable Oil/Protein System program working paper series", Egerton University,; Njoro, Kenya, 1988.
47. Ogoke I, Carsky R, Togun A, Dashiell K. Maturity Class and P Effects on Soybean grain yield in the moist savanna of West Africa. J. Agron. Sci,2003:189:422-427.
48. Oplinger ES, Philbrook BD. Soybean planting date, row width and seeding rate response in three tillage systems. J. Prod. Agric,1992:5:94-99.
49. Orellana M, Barber R, Diaz O. Effect of deep tillage and fertilization on soyabean. J. Agron. Crop Sci,1990:190:216-223.
50. Patel SR, Naik ML, Chandra VBR. Effect of nitrogen and phosphorus levels on growth, yield and protein content of soybean (*Glycin max*.). J. Oilseeds Res,1992:9(2):202
51. Pedersen P, Lauer C. Corn and soybean response to rotation sequence, row spacing, and tillage System Agron J,2003:95:965-971
52. Rajcan I, Hou G, Weir A. Advances in Breeding of Seed-Quality Traits in Soybean. In: Manjit and Kang (Eds.). Genetic and Production Innovations in Field Crop Technology: New Developments in Theory and Practice Food Products Press, 2005, 145-174.
53. Salvagiotti F, Specht J, Cassman K, Walters D, Weiss A, Dobermann A. Growth and nitrogen fixation in high-yielding soybean: impact of nitrogen fertilization. Agron J,2009:101:958-970
54. Schulze J, Temple G, Temple S, Beschow H, Vance C. Nitrogen fixation by white lupin under phosphorus deficiency Ann. Bot,2006:98:731-740
55. Sharma H, Nahatkar S, Patel M. Constraints of soybean production in Madhya Pradesh: An analysis. Bhartiya Krishi AnusandhanPatrika,1996:11(2):79-84.
56. Shurtleff W, Aoyagi A. History of soybeans and soy foods in Africa (1857-2009). Soy Info Center ISBN: 978-19289114-25-9 Lafayette, CA, 2009
57. Sinclair T, Marrou H, Soltani A, Valdez V. Soybean production in Africa Glob Food Biol, 2014. doi:10.1016/j.fgs.20131.
58. Smith K, Huyser W. World Distribution and Significance of Soybean P. 1.*In* J.R. Wilcox (ed.) soybeans: Improvement, Production, and Uses. Second Edition, 1987.
59. Starling M, Wood C, Weaver D. Late-planted soybeans respond to nitrogen starter. Fluid J,2000:28:26-30
60. Tahir M, Abbasi M, Rahim N, Khaliq A, Kazmi M. Effect of Rhizobium inoculation and NP fertilization on growth, yield and nodulation of soybean (*Glycine max* L.) in the sub-humid hilly region of Rawalakot Azad Jammu and Kashmir, Pakistan. Afr. J. Biotechnol,2009:8:6191-6200.
61. Tarekegne A, Tanner D. Effects of fertilizer application on N and P uptake, recovery and use efficiency of bread wheat grown on two soil types in central Ethiopia. Ethiopian, 2001.
62. Tesfaye A, Githiri M, Derera J, Debele T. Subsistence farmers' experience and perception about the soil and fertilizer use in Western Ethiopia. Ethiopian Journal of Applied Sciences and Technology,2011:2:61-74.
63. Tesfaye A, Githiri M, Derera J, Debele T. Smallholder Farmers' perception and experience on the importance, consumption and market of soybean in Western Ethiopia. Asia-Pacific Journal of Rural Development,2010:20:125-139.
64. Thoenes P. "Soybean International Commodity Profile, Markets and Trade Division Food and Agriculture Organization of the United Nations", 2014, 1-25.
65. Thomas D, Erostus N. Soybean Research in Africa for 30 years IITA Research for development review, 2008. http://www IITA Research
66. Tripathi B, Hazra R, Srivas C. Effect of nitrogen sources with and without phosphorus an oats. Indian J. Agric. Res,1992:25(2):79-84.
67. Uchida R. Essential nutrients for plant growth: Nutrient functions and deficiency symptoms. Plant nutrient management in Hawaii's soils. College of Tropical

Agriculture and Human Resources, University of Hawaii at Manoa, 2000, 31-55.
68. Weaver D, Akridge R, Thomas A. Growth habit, planting date, and row-spacing effects on late-planted soybean Crop Sci,1991:31:805-810
69. Whigham K. "Soybean Production, Protection, and Utilization", Proceedings of a Conf. for Scientists of Africa, The Middle East, and South Asia, University of Illinois International Soybean Program Urbana, Illinois 61801, 1974, 1-266.
70. Wold-maskel E. Genetic Diversity of Rhizobia in Ethiopian Soils: Their Potential to Enhance Biological Nitrogen Fixation (BNF) and Soil Fertility for Sustainable Agriculture. Ethiopian Journal of Biological Sciences,2007:6(1):77-95.
71. Wood C, Torbert A, Weaver D. Nitrogen fertilizer effects on Soybean Growth, Yield and Seed Composition Journal of Production Agriculture, 1993, 6(3)
72. Worku M, Astatkie T. Row and Plant Spacing Effects on Yield and Yield Components of Soybean Varieties under Hot Humid Tropical Environment of Ethiopia Journal of Agronomy and Crop Science,2011:197:67-74
73. Yusuf I, Idowu A. Evaluation of four soybean varieties for performance under different lime regimes on the acid soil of Uyo Trop. Oil Seeds J,2001:6:65-70.
74. Zafar M, Abbasi K, Rahim N, Khaliq A, Shaheen A, Jamil M *et al*. Influence of integrated phosphorus supply and plant growth promoting rhizobacteria on growth, nodulation, yield and nutrient uptake in Phaseolus vulgaris. Afr. J. Biotechnol,2011:10:16781-16792